Revised May 2021

Profilograph Simulation Field Guide

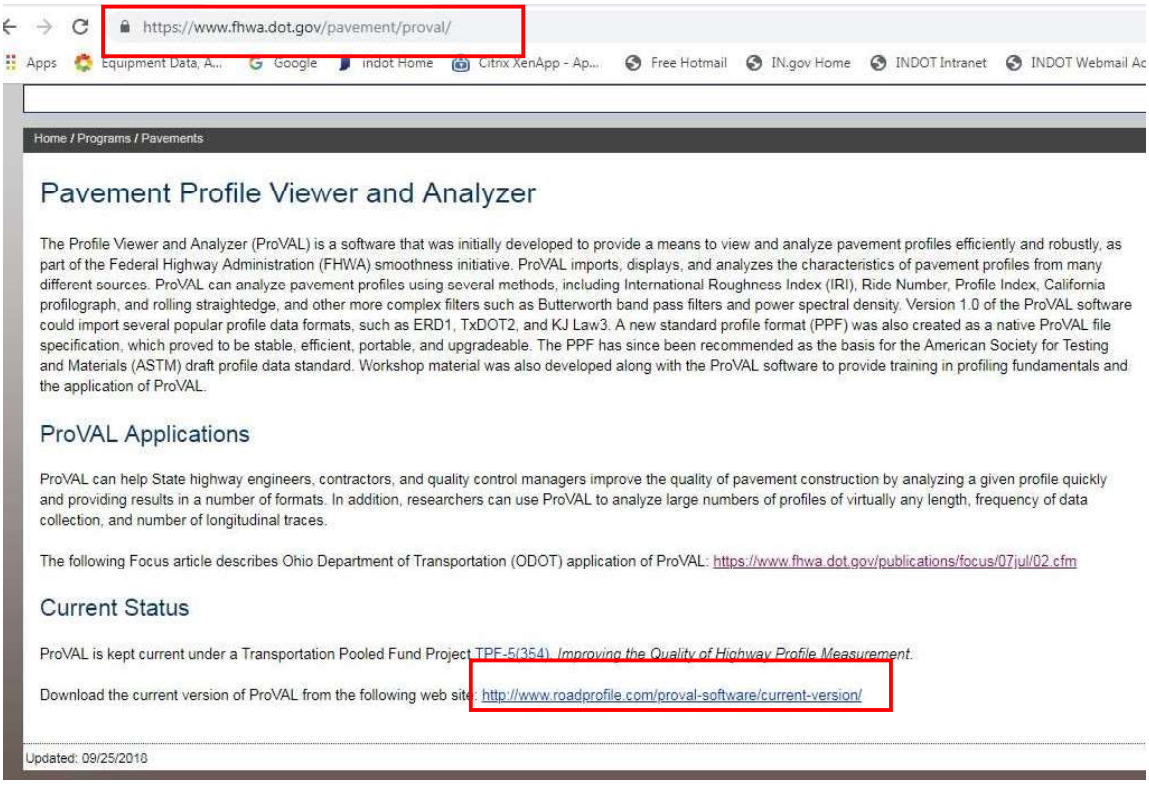
(Profilograms in pdf format that are generated by the high-speed profiler software and meet the requirements SS 401.18 may be accepted in place of data files. The profilograms provided will be analyzed, reviewed, and utilized for payment in the same manner as profilograms generated by current profilograph equipment and in accordance with SS 401.18.)

*** Steps 1 to 8 are copied from the IRI Field Guide for Smoothness Pay**

**** Steps 1-8 are to be performed by the contractor and the resulting ProVal ppf files shall be supplied to INDOT PE/PS for review and analysis. In addition, the original raw data files shall be available to INDOT for review in ProVal if requested during the life of the contract.**

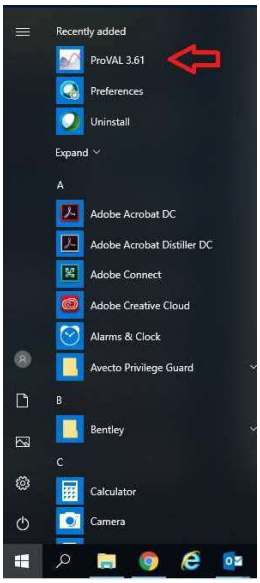
***** Steps 9 to 17 are to be performed by INDOT PE/PS to analyze the ProVal ppf files and download profilograph data from ProVal in order to determine smoothness payment and areas in need of corrective grinding .**

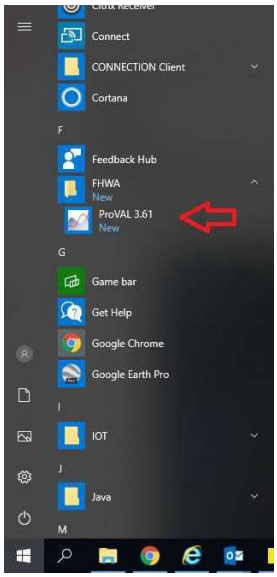
ProVAL Applications can be downloaded from FHWA website:
https://www.fhwa.dot.gov/pavement/proval/

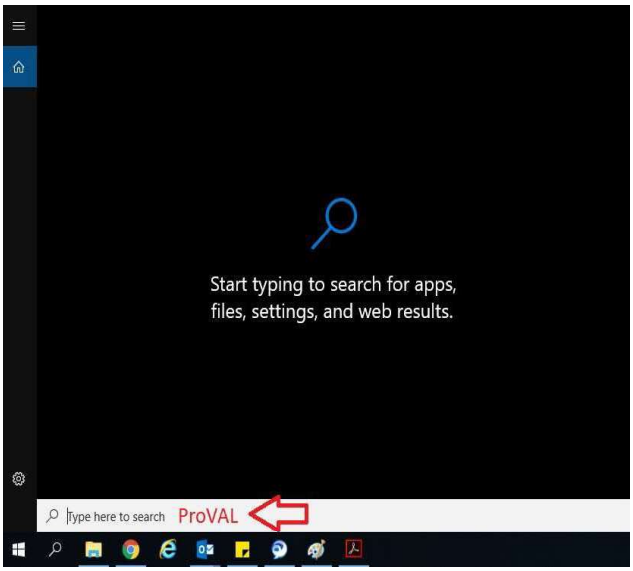


1) Open up ProVAL by either going to the Start button → All Programs → FHWA → ProVAL or typing ProVAL into the search bar located in the Start menu.

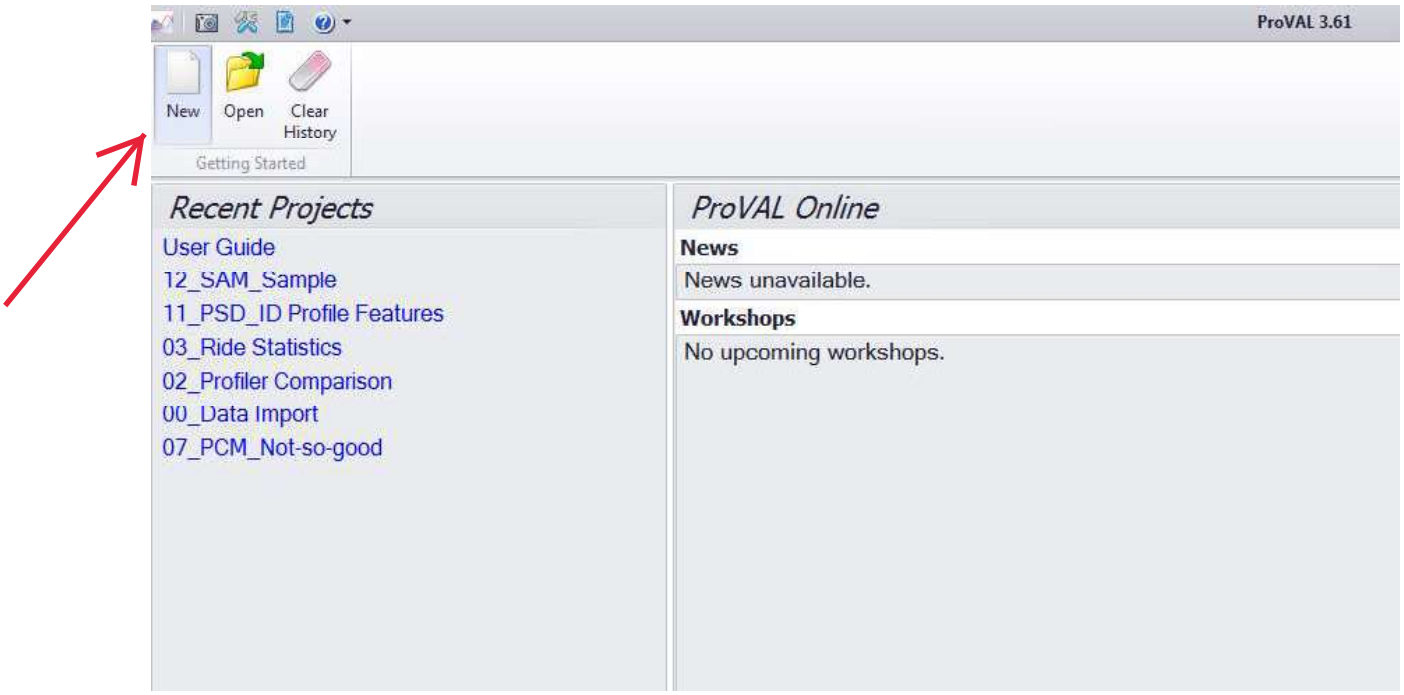
(Windows 10)



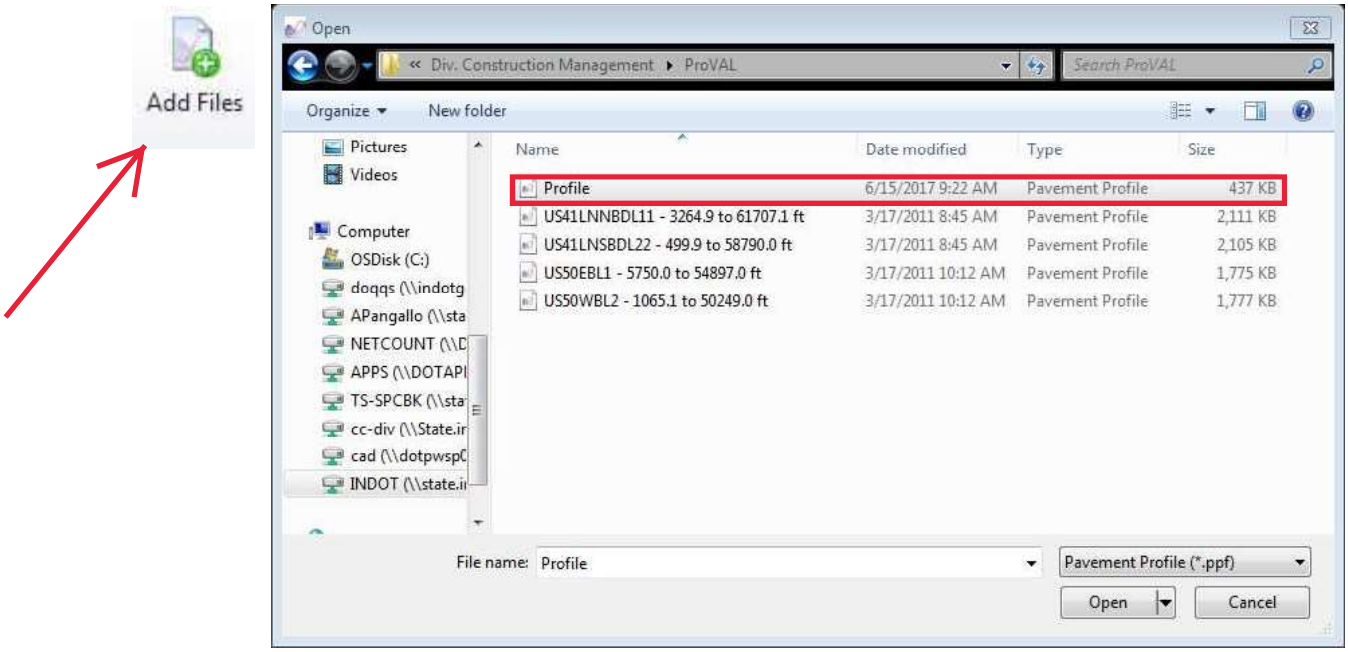




2) Select **New** to begin a new project file

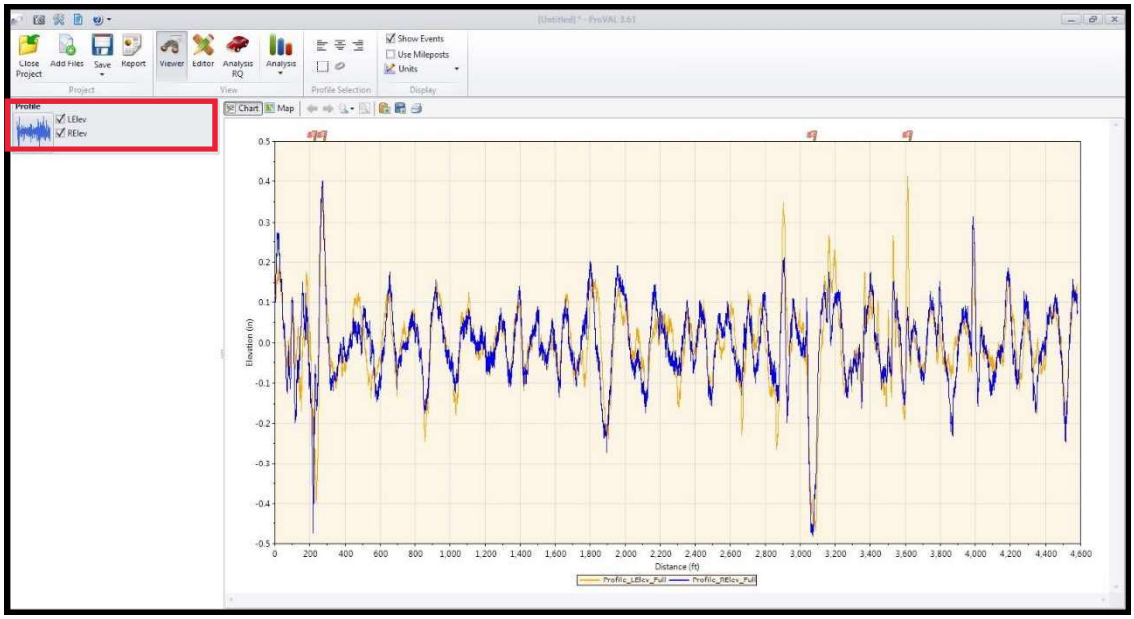


3) The data file the Contractor has sent needs to be downloaded onto this project file. Select **Add Files** and browse the folders where you placed the Contractor's data file (window below is only an example of a folder location) and open it.

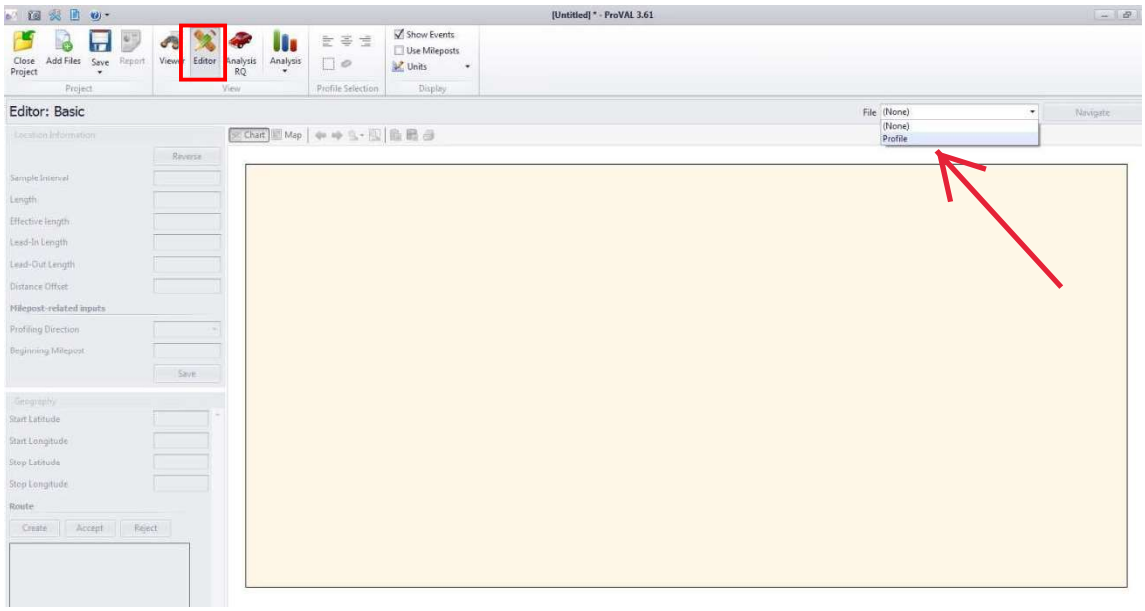


As more data is received, additional files should be added to this one project file to represent all the testing for a contract.

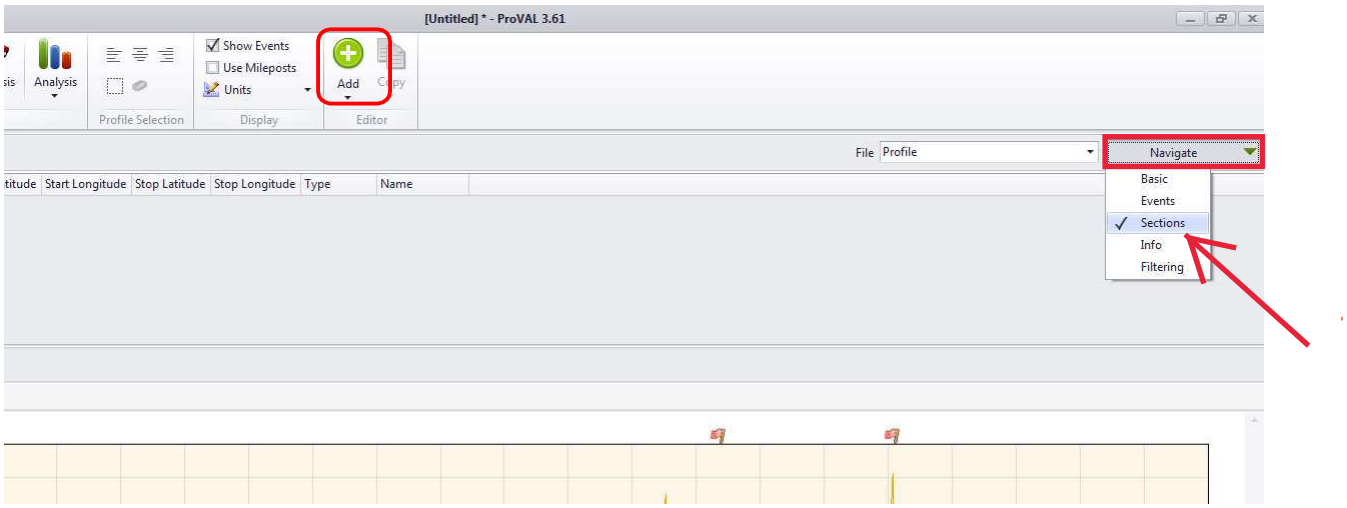
4) A data file will automatically begin in the Viewer pane. Each file will have two checkboxes for left and right wheel path readings. Clicking on these checkboxes will display the profile data readouts for the Section tested. The x-axis is listed in feet starting at 0 feet and up to the distance measured by the inertial profiler.



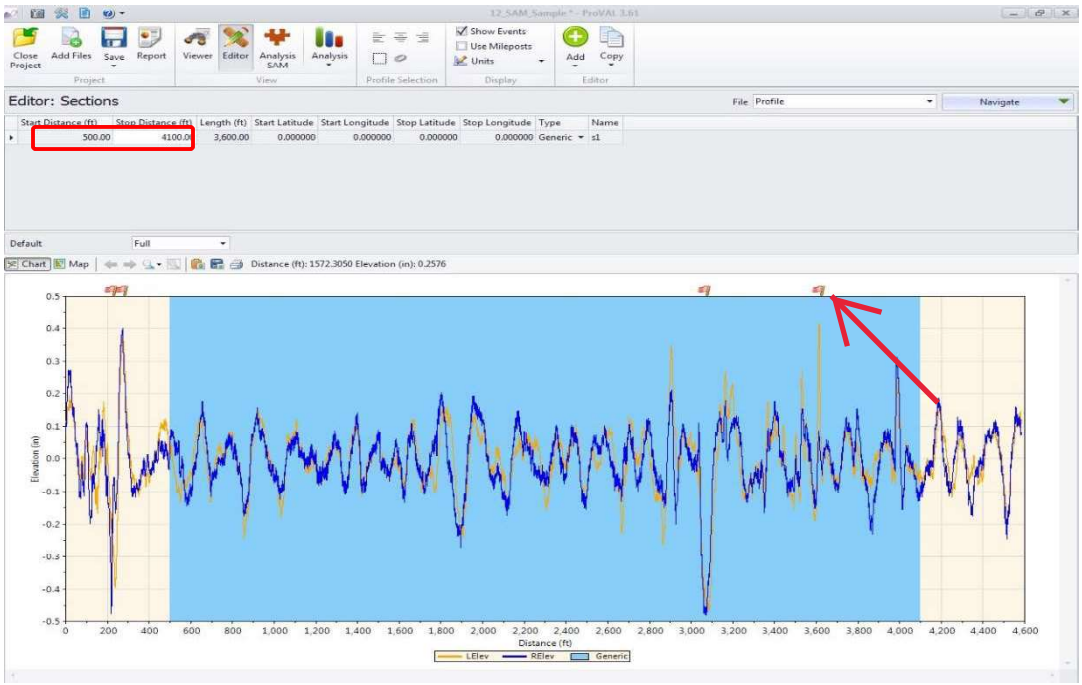
5) Next, the section needs to be identified for analysis. Not all sections start at 0 feet as can be seen above in the example. The starting feet on this graph needs to correspond with a station that represents the start of paving. To identify the section, select the **Editor** icon. Now select which file you want to use from the File dropdown.



6) Once the file is selected, you will notice the profile data results appear as they did on the Viewer pane. Click the **Navigate** dropdown to the right of File dropdown and select **Sections**. Next, click the **Add** button and provide a meaningful name that helps identify this exact section (Line/Direction/Lane/etc.).

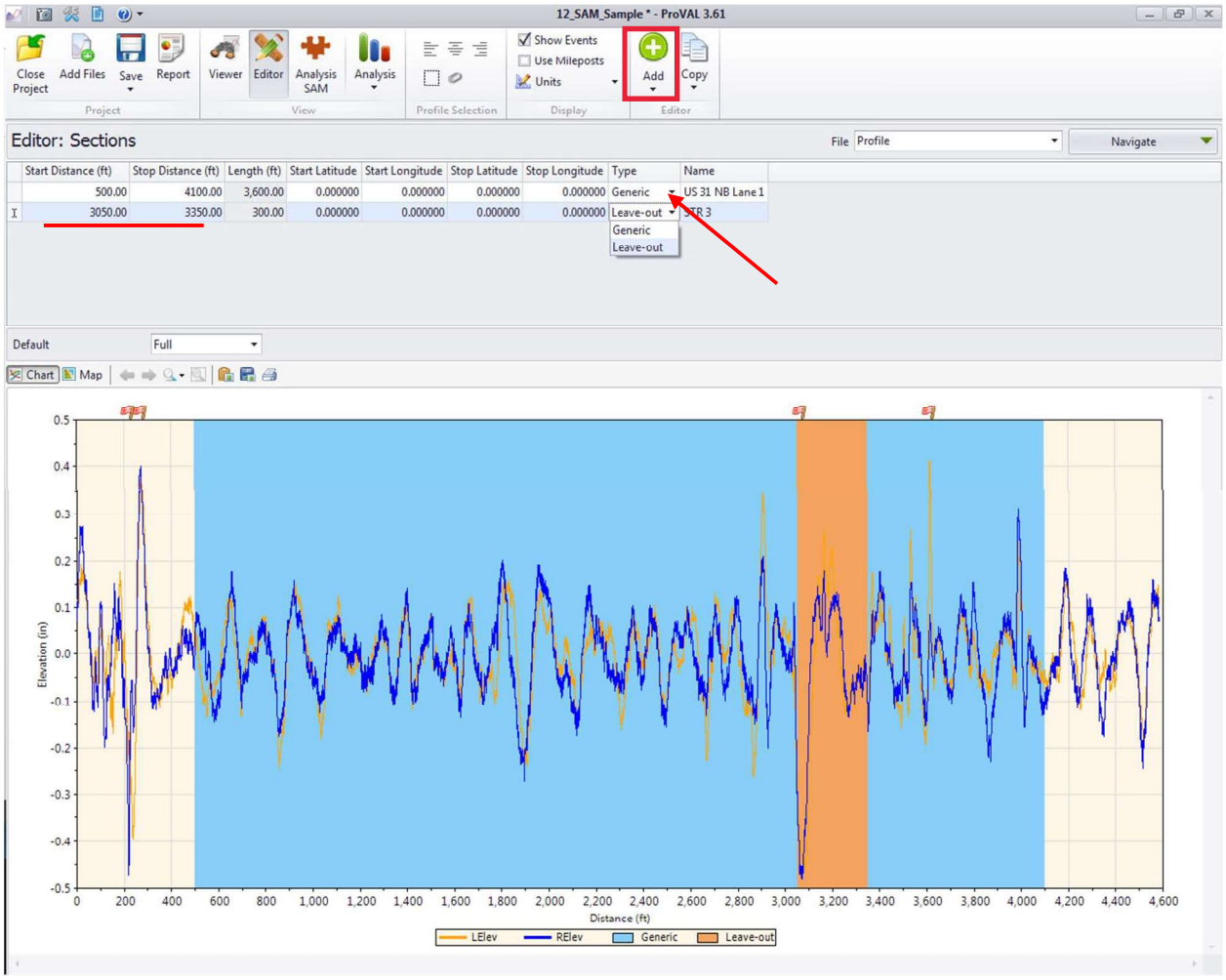


7) Provide the Start Distance and Stop Distance at which the Surface was measured for the contract. The distances will not always match up to your typical section stations. For example, the inertial profiler started taking measurements 500' before the construction limits and ended 500' past the construction limits on the other side of the contract. The total distance measured was 4600'. The starting station for paving is 0+00. That means distance 500' would be station 0+00 since the inertial profiler started measuring 500' before the paving limits. One of the exceptions for the inertial profiler is the first and last 50' of paving. Therefore, the Start Distance would be 550' and the Stop Distance would be 4050'. You will notice the blue shaded area will now shrink to the limits entered.



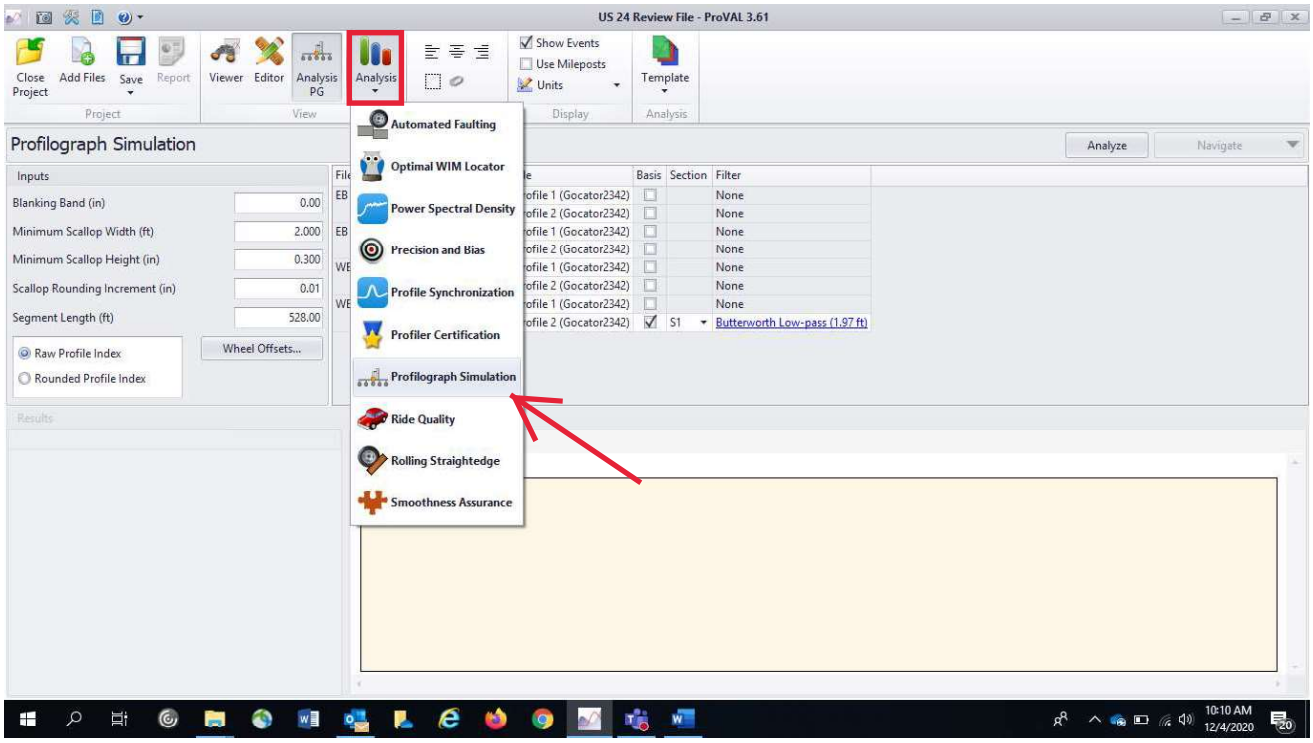
Red Flags can be seen right above the graph. These red flags represent **Events**. Events are usually accompanied by spikes in profile data because of a bridge, casting, railroad crossing or other feature that would cause a bump unrelated to the actual pavement. ITM 917 describes these and exempts 50' before through 50' after these features from measurement. The contractor should help identify these locations which should already be marked in the file before you receive it.

8) Once these exceptions are identified, these areas need to be excluded from measurement. Click **Add** button within Editor and provide a name that describes the exception such as STR 3 for a bridge. The Start Distance should be 50' before and then the Stop Distance should be 50' after the end of the feature. For example, there is a bridge that is 160' long with 20' approaches and the first approach begins at 3100'. The Start Distance should be entered as 3050' and the Stop Distance should be 3350'.
The only difference between this section and the previous section is the selection for the dropdown under the Type column. Select **Leave-Out**.

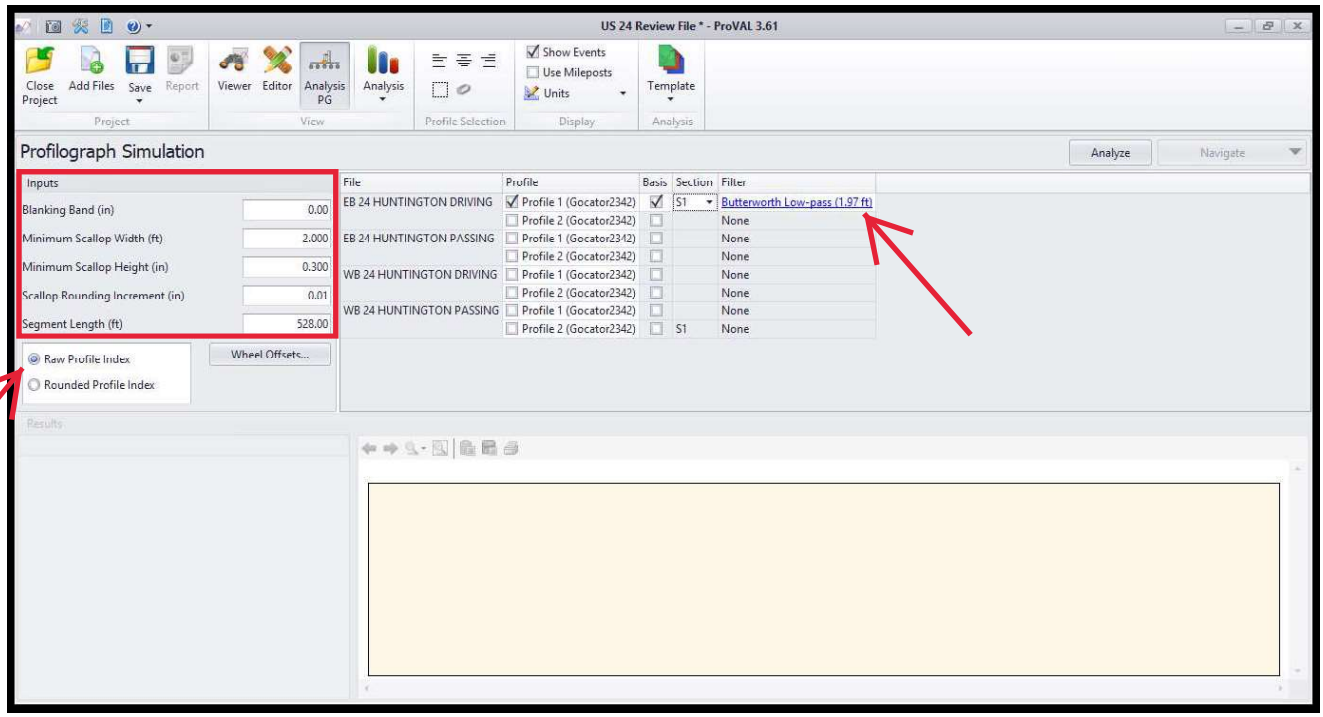


You will notice that the bridge can be seen as the orange shaded area. This area will now be excluded from analysis. Repeat this process for all exceptions located within the section.

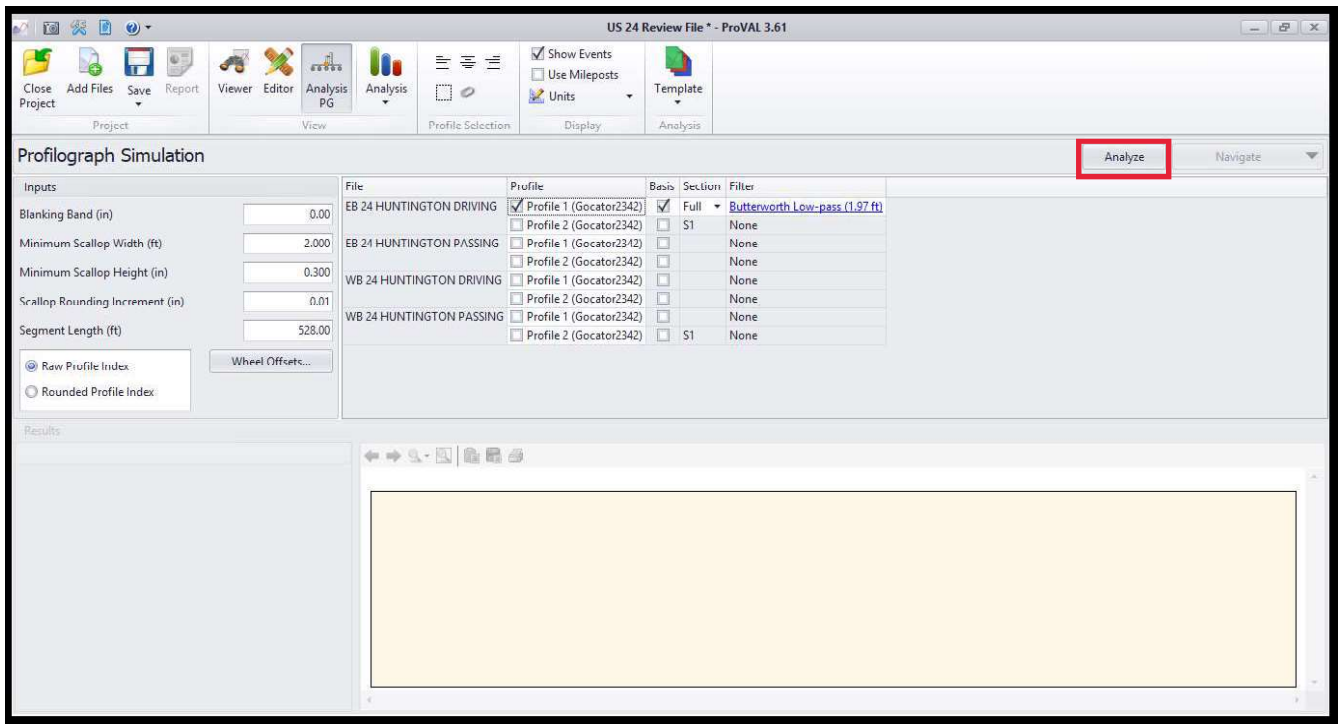
9) Now it is time to analyze the Section in Profilograph Simulation Mode and eventually output data to obtain pay factors (PF) for smoothness quality adjustments and locate areas in need of corrective action. Click the **Analysis** button and select **Profilograph Simulation** from the dropdown.



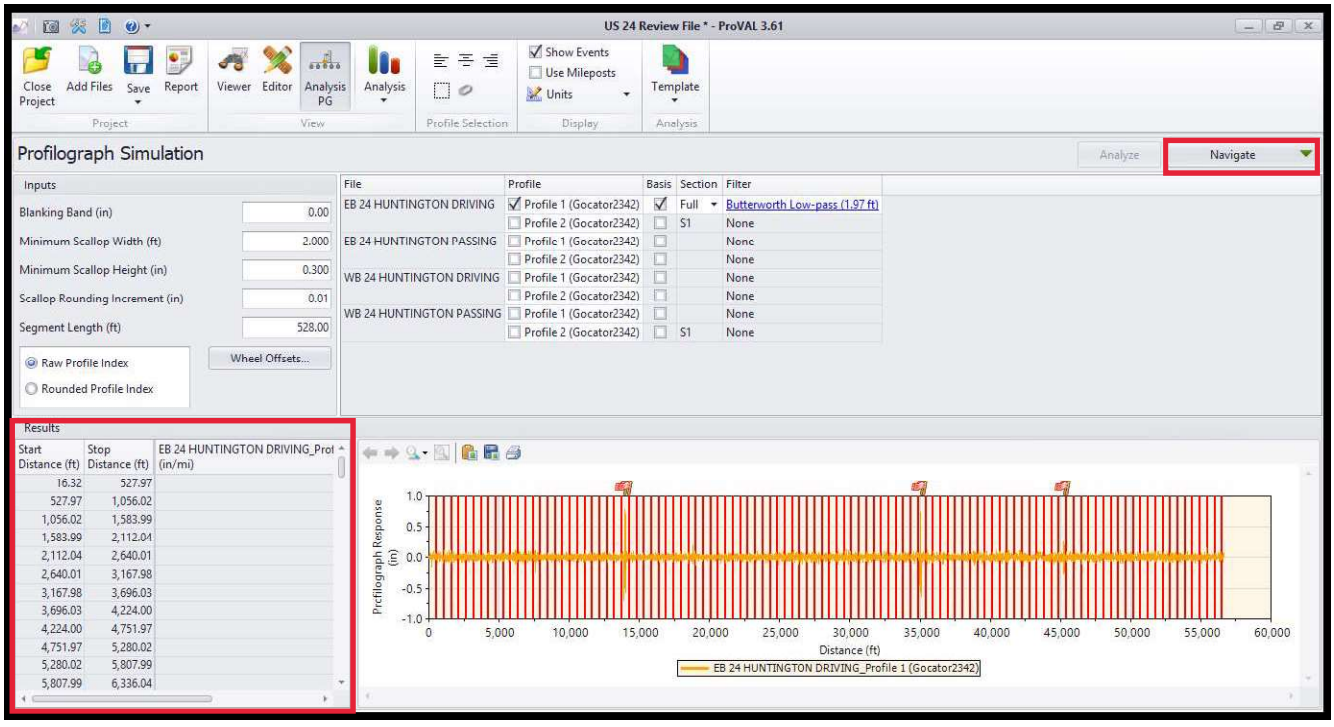
10) The standard specification explains that a 0.3 inch deviation is the threshold for corrective action and that smoothness measurement for payment is based on 0.1 miles or 528 ft. Set the parameters for analysis as: Blanking Band set to 0.00 in, Min Scallop Width to remain at default 2.00 ft, Min. Scallop Height set to 0.3 in, Scallop Rounding Increment set to 0.01 in, Segment Length to remain at default 528 ft, and finally click on the Raw Profile Index. Next, select the data file you want to analyze and select basis for the same file, then select S1 for Section and Butterworth Low Pass 1.97 ft for the filter.



11) Now that the Profilograph Simulation has been set to meet the specifications, and the file to be analyzed has been selected and filtering is set. Click the **Analyze** button in the top right corner.

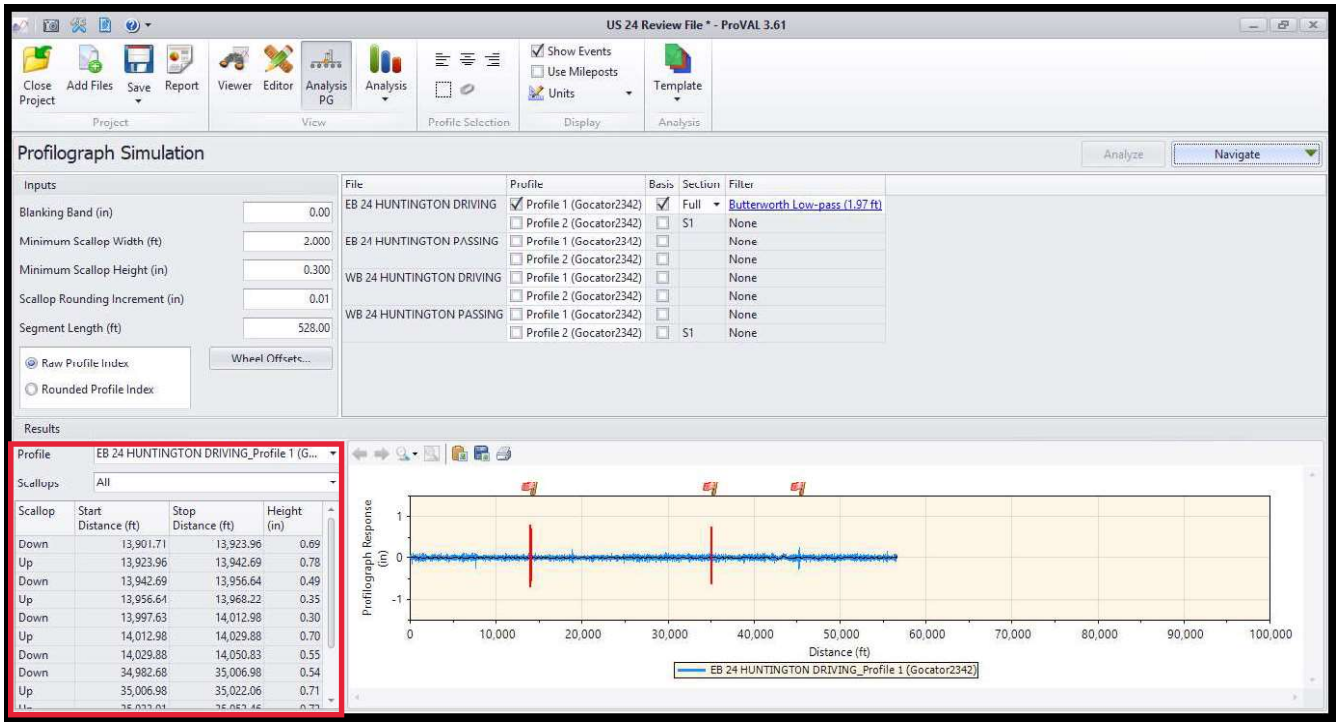


12) Once the analysis is complete, the profilograph simulation results will be available as a chart and in table form as shown below. There are scrolls both vertical and horizontal to allow viewing of the results. Next, select **Navigate** in the upper right corner and click on **Scallops** for the remaining portion of the analysis.

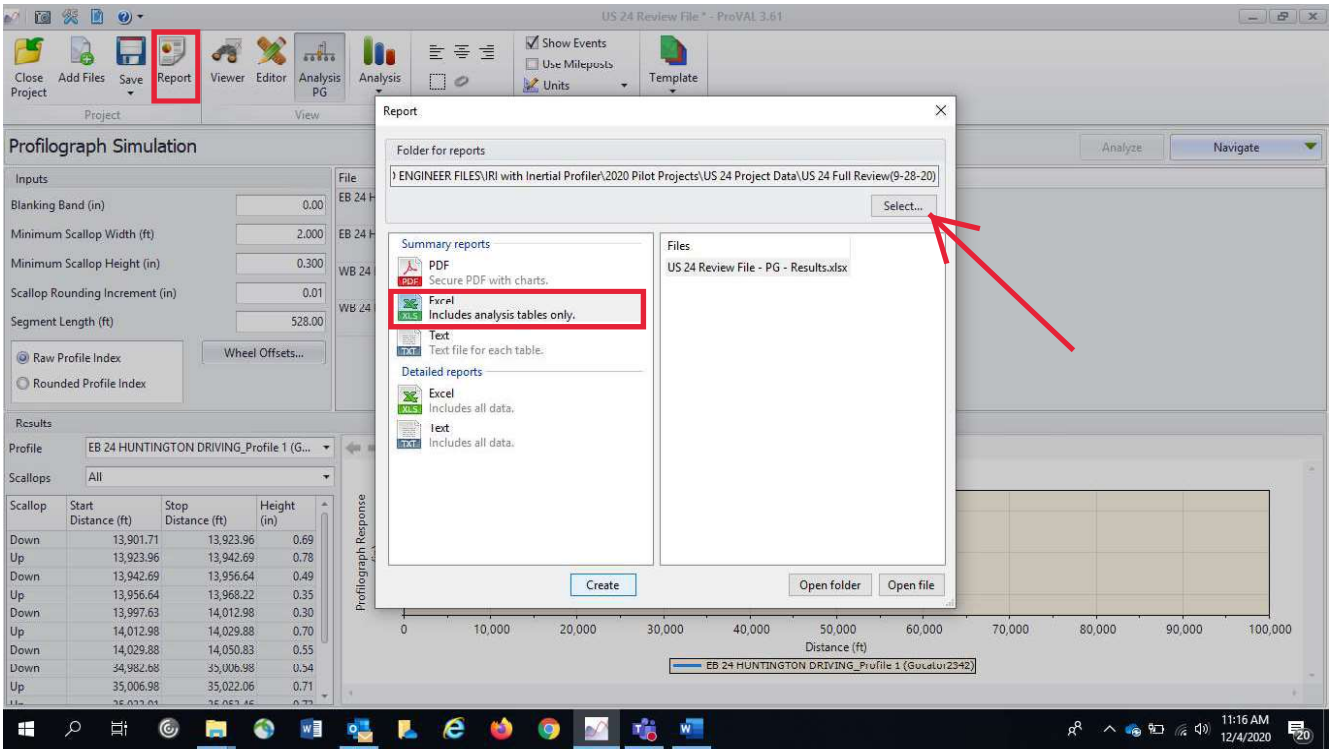


13) Once the 2nd portion of the analysis is complete, the profilograph scallop results will be available as a chart and in table form as shown below. There is a scroll to allow viewing of the results which will indicate each location where the 0.3 inch deviation threshold was exceeded.

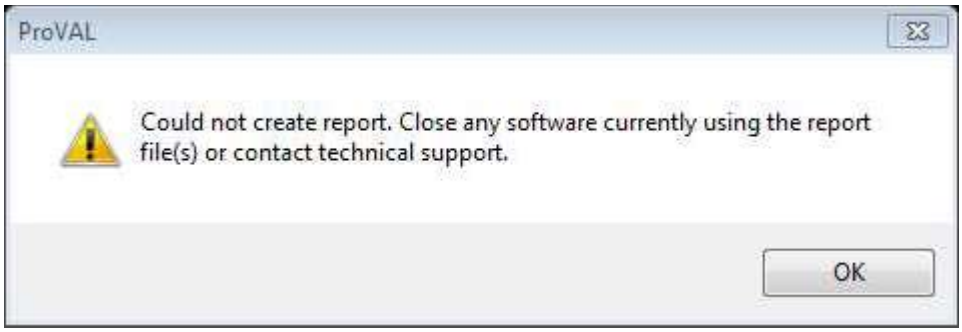
(Note b/c this is a profilograph simulation based on data collected by a high speed inertial profiler; data is collected and analyzed for both wheel paths as opposed to a single wheel path which is typically collected by profilograph equipment)

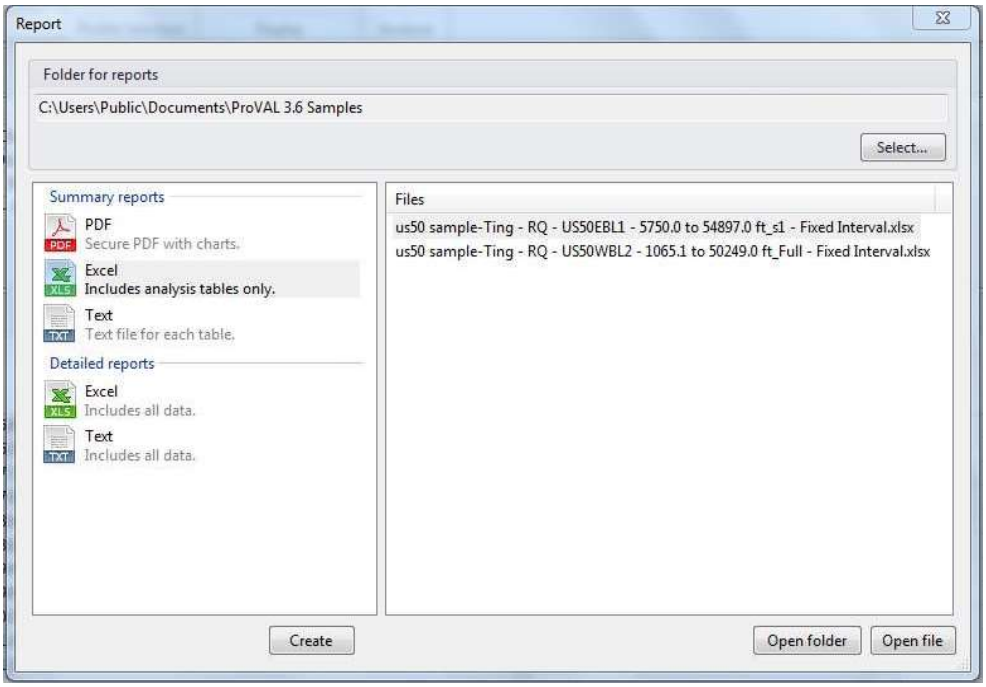


14) After that, select the **Report** button. You can click Select to browse folders for the destination of the report. Once a folder is selected, choose the Excel includes analysis tables only option on the left and click create.

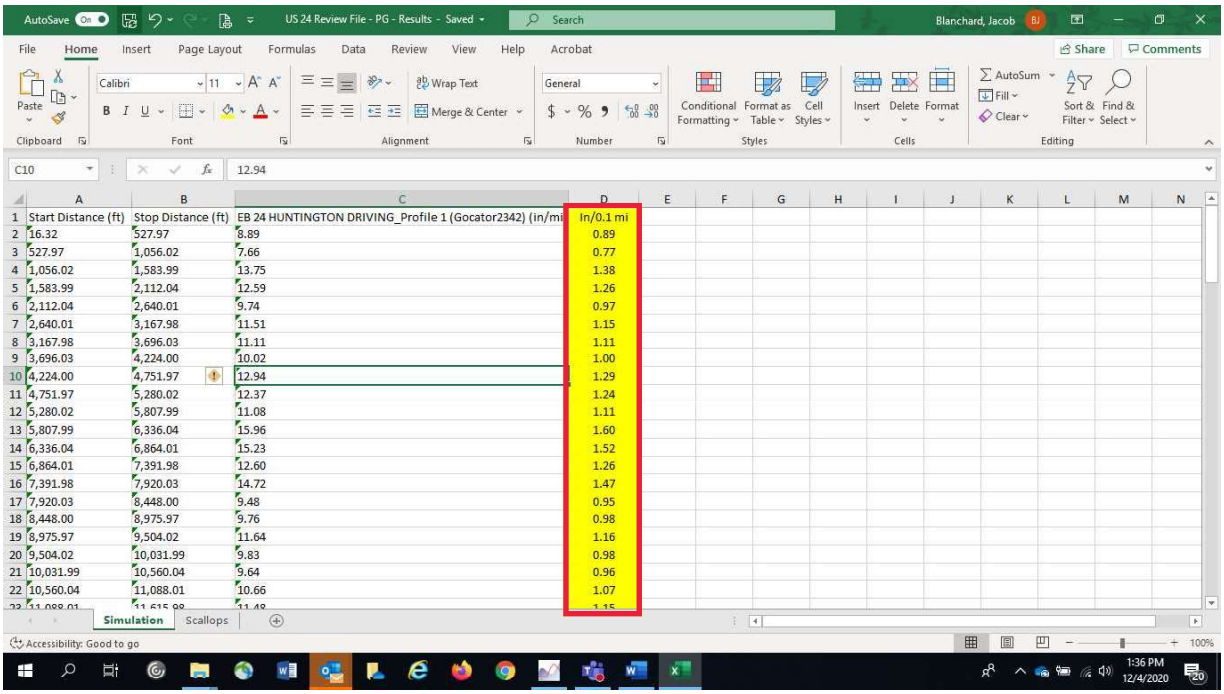


***If you get this screen below, you may have a spreadsheet with the same exact name but by a different user. Either select a different folder or delete the old spreadsheets. ***



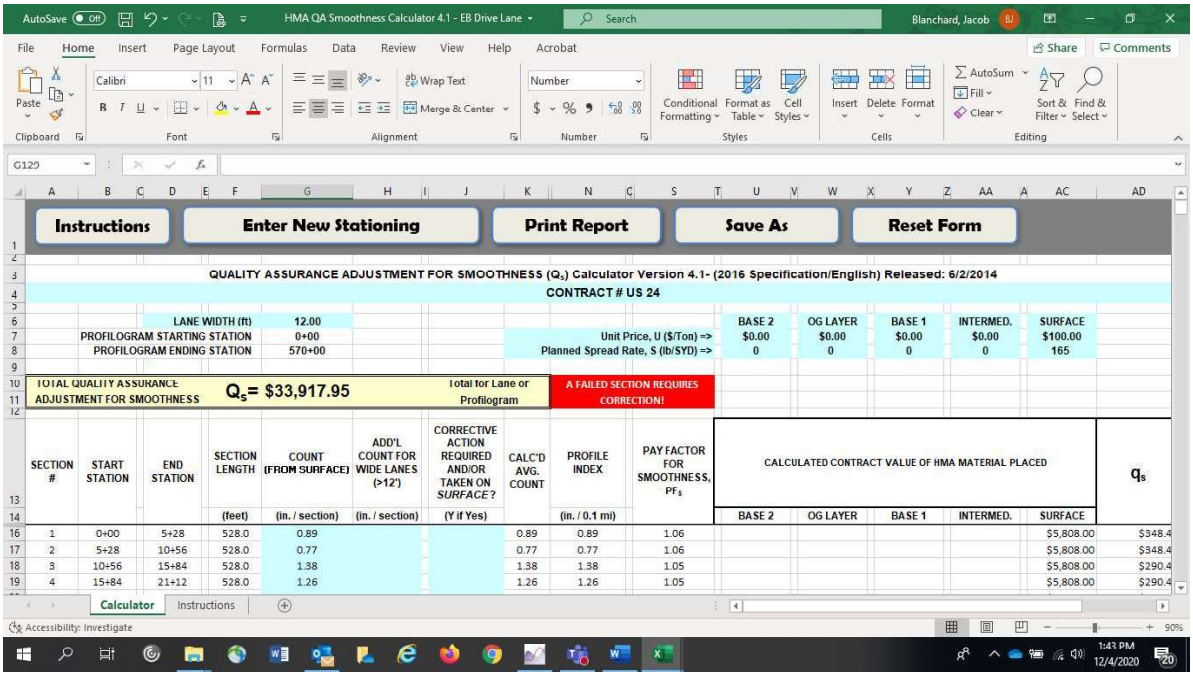


15) Open the spreadsheet you created from ProVAL. The spreadsheet should have the project file's name with columns of start distance, stop distance, and profile in inches/mile. Add a new column with heading (inches/0.1 mile) and divide the inches per mile column (column C below) by 10 for this conversion (Yellow Column below is the new column).



Start Distance (ft)	Stop Distance (ft)	EB 24 HUNTINGTON DRIVING_Profile 1 (Gocator2342) (in/mi	In/0.1 mi
16.32	527.97	8.89	0.89
527.97	1,056.02	7.66	0.77
1,056.02	1,583.99	13.75	1.38
1,583.99	2,112.04	12.59	1.26
2,112.04	2,640.01	9.74	0.97
2,640.01	3,167.98	11.51	1.15
3,167.98	3,696.03	11.11	1.11
3,696.03	4,224.00	10.02	1.00
4,224.00	4,751.97	12.94	1.29
4,751.97	5,280.02	12.37	1.24
5,280.02	5,807.99	11.08	1.11
5,807.99	6,336.04	15.96	1.60
6,336.04	6,864.01	15.23	1.52
6,864.01	7,391.98	12.60	1.26
7,391.98	7,920.03	14.72	1.47
7,920.03	8,448.00	9.48	0.95
8,448.00	8,975.97	9.76	0.98
8,975.97	9,504.02	11.64	1.16
9,504.02	10,031.99	9.83	0.98
10,031.99	10,560.04	9.64	0.96
10,560.04	11,088.01	10.66	1.07

16) You are now ready to compute smoothness adjustments with the Excel Spreadsheet. Open the departments **HMA QA Smoothness Calculator 4.1** spreadsheet utilized for profilograph smoothness data analysis for payment. Copy and past columns A, B, and D into the appropriate columns in the analysis spreadsheet as you would with profilograph data. The spreadsheet will calculate the smoothness incentives/disincentives and will notify of any segments that will require corrective action as normal.



Instructions | Enter New Stationing | Print Report | Save As | Reset Form

QUALITY ASSURANCE ADJUSTMENT FOR SMOOTHNESS (Q_s) Calculator Version 4.1- (2016 Specification/English) Released: 6/2/2014

CONTRACT # US 24

LANE WIDTH (ft) 12.00
PROFILOGRAM STARTING STATION 0+00
PROFILOGRAM ENDING STATION 570+00

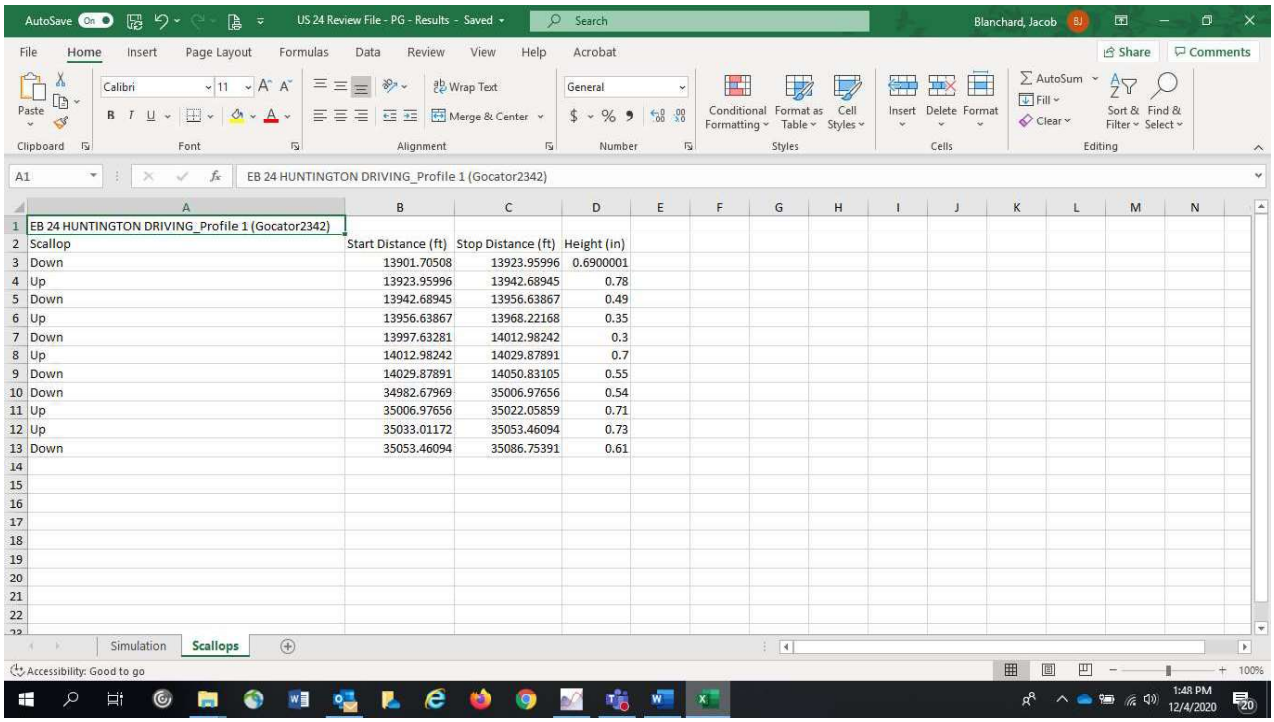
	BASE 2	OG LAYER	BASE 1	INTERMED.	SURFACE
Unit Price, U ($/Ton) =>	$0.00	$0.00	$0.00	$0.00	$100.00
Planned Spread Rate, S (lb/SYD) =>	0	0	0	0	165

TOTAL QUALITY ASSURANCE ADJUSTMENT FOR SMOOTHNESS Q_s= $33,917.95 — Total for Lane or Profilogram

A FAILED SECTION REQUIRES CORRECTION!

SECTION #	START STATION	END STATION	SECTION LENGTH (feet)	COUNT (FROM SURFACE) (in. / section)	ADD'L COUNT FOR WIDE LANES (>12') (in. / section)	CORRECTIVE ACTION REQUIRED AND/OR TAKEN ON SURFACE? (Y if Yes)	CALC'D AVG. COUNT	PROFILE INDEX (in. / 0.1 mi)	PAY FACTOR FOR SMOOTHNESS, PF_s	CALCULATED CONTRACT VALUE OF HMA MATERIAL PLACED					Q_s
										BASE 2	OG LAYER	BASE 1	INTERMED.	SURFACE	
1	0+00	5+28	528.0	0.89			0.89	0.89	1.06					$5,808.00	$348.4
2	5+28	10+56	528.0	0.77			0.77	0.77	1.06					$5,808.00	$348.4
3	10+56	15+84	528.0	1.38			1.38	1.38	1.05					$5,808.00	$290.4
4	15+84	21+12	528.0	1.26			1.26	1.26	1.05					$5,808.00	$290.4

17) The ProVal spreadsheet created will also have a tab showing all of the scallops which may be used to locate bumps and dips in the field greater than 0.3 inch deviations which require corrective action. The distances shown will not necessarily line up with project stationing, the starting point of the high speed profiler run should be noted as an anchor point and any other known features such as bridges along the route may be utilized as anchor points and reviewed in ProVal editor tab under sections as to the exact distance of the bridge anchor point. The bump locations can then be measured from the anchor points and found more accurately in the field. There is also a map function with aerial views of the project high speed profiler route that may be used for locating anchor points visually.



EB 24 HUNTINGTON DRIVING_Profile 1 (Gocator2342)			
Scallop	Start Distance (ft)	Stop Distance (ft)	Height (in)
Down	13901.70508	13923.95996	0.6900001
Up	13923.95996	13942.68945	0.78
Down	13942.68945	13956.63867	0.49
Up	13956.63867	13968.22168	0.35
Down	13997.63281	14012.98242	0.3
Up	14012.98242	14029.87891	0.7
Down	14029.87891	14050.83105	0.55
Down	34982.67969	35006.97656	0.54
Up	35006.97656	35022.05859	0.71
Up	35033.01172	35053.46094	0.73
Down	35053.46094	35086.75391	0.61